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Los Alamos
NATIONAL LABORATORY

ESRA Mission Overview for MMO

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On behalf of the entire ESRA team

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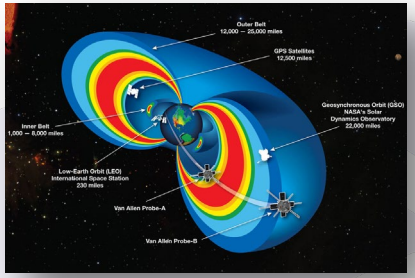
Mission Overview

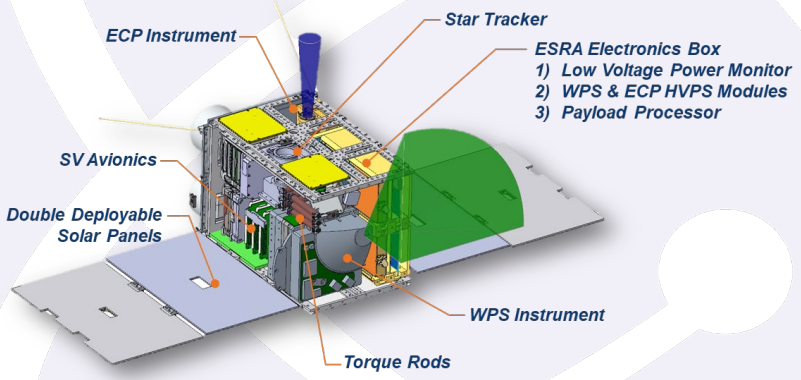
- The Experiment for Space Radiation Analysis (ESRA) is a pathfinder for rapid Demonstration and Validation (DemVal) missions that the Los Alamos National Laboratory will fly on a 4-year cadence

Primary goal is to provide TRL maturation and risk reduction for next generation systems.

- Utilization of commercial spacecraft and ground station vendors allows for reduced risk and cost
  - Partnered with NanoAvionics for 12U bus
  - Partnered with KSAT for ground segment
- Enables LANL technical staff to focus on payload development
- Launch and integration provided by the Mission Manifest Office (MMO) and DoD Space Test Program (STP)
- ESRA will be one of the first CubeSats to operate in GTO



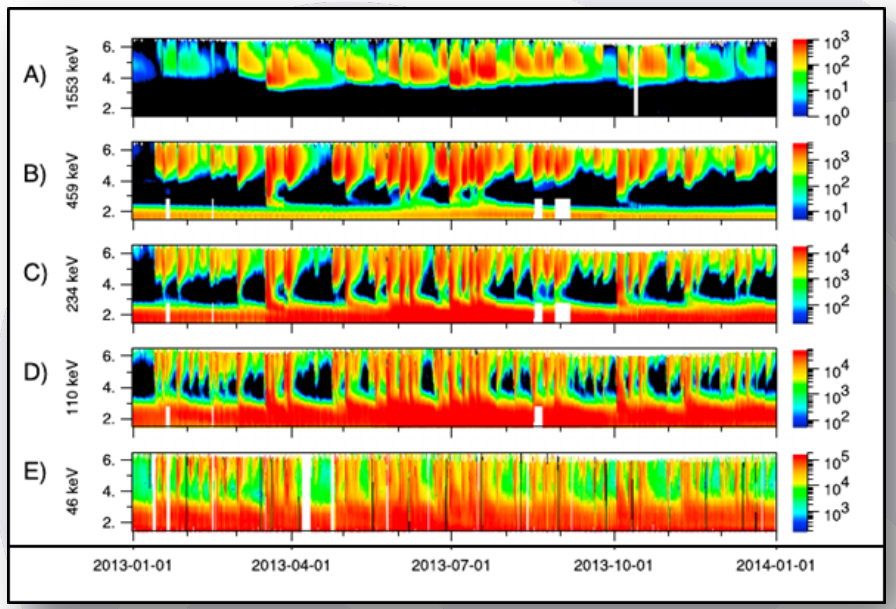
Earth's radiation belts illustrating the Van Allen Probe Mission in geostationary transfer orbit (GTO). Image courtesy of NASA



ESRA 12U CubeSat CAD

Mission Goals

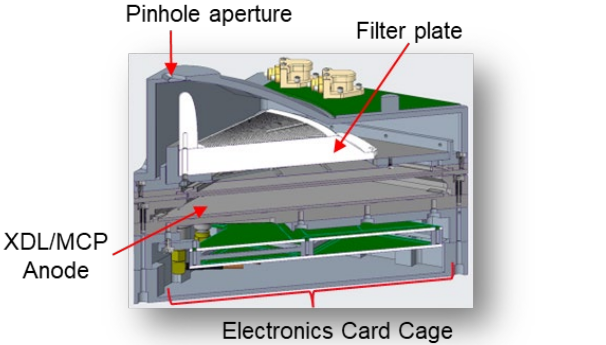
- Legacy space weather instruments provide a wealth of data but are resource intensive
  - Size, Weight, and Power - Cost (SWaP-C)
- Measurements of the local space environment are critical for anomaly resolution and space domain awareness
- A new generation of plasma and energetic particle sensors are being developed to provide the necessary data with lower SWaP-C
  - Wide-field-of-view Plasma Spectrometer (WPS)
  - Energetic Charged Particle (ECP) Telescope
- ESRA will achieve all mission requirements after six months
  - Bus shielding designed to last for 1 year based on the natural radiation environment
  - Payload anticipated to operate well beyond 1 year if the spacecraft can support
- After successfully demonstrating technology and providing risk reduction the payloads will contribute to scientific collection

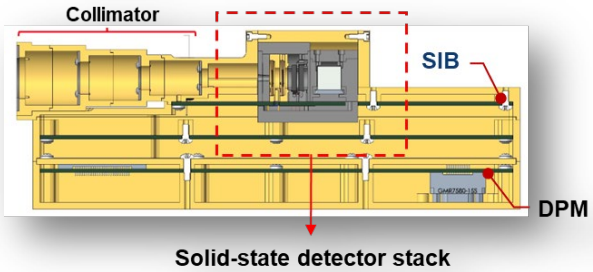


Reeves, G. D., et al. (2016), Energy-dependent dynamics of keV to MeV electrons in the inner zone, outer zone, and slot regions, J. Geophys. Res. Space Physics, 121, p. 397–412.

Sensor Payloads

Objective: On-orbit validation of the Wide-field-of-view Plasma Spectrometer **(**WPS) and Energetic Charged Particle (ECP) sensors' ability to measure proton and electron fluxes associated with the four major types of space environmental hazards: 1) total event dose; 2) single event effects; 3) deep dielectric charging; and 4) surface charging



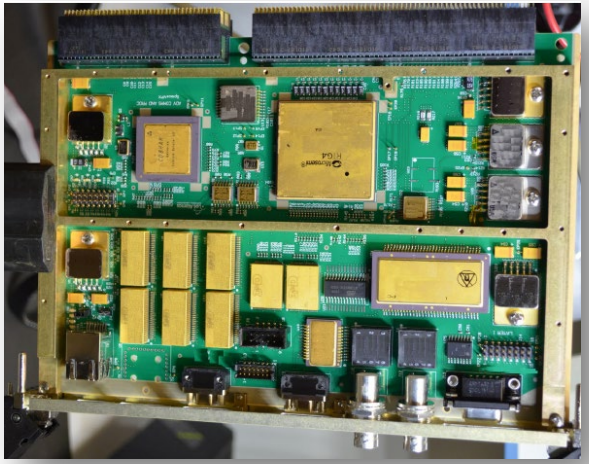


Description:

- The WPS will measure ions 0.1 – 35 keV/q
  - The WPS design is based on pin-hole camera concept, allowing for significantly increased field-of-view (FOV) compared to standard electrostatic analyzers
- The ECP telescopes will measure protons (p+): ≥100 keV – 1000 MeV and electrons (e-): ≥100 keV – 10 MeV
  - GAGG scintillator will allow for increased detection efficiency when compared to YSO
- Sensor performance can be compared against current on-orbit payloads in addition to the previous AFRL Demonstration and Science Experiments (DSX) and NASA Van Allen Probes data sets
- WPS/ECP data will also be compared against the AE9/AP9 model

Critical Sub-System Payloads

Objective: Study and evaluate new technologies; Payload Processor, Distributed Processor Module (DPM), Flight Software (FSW) architecture, and High Voltage Power Supply (HVPS).

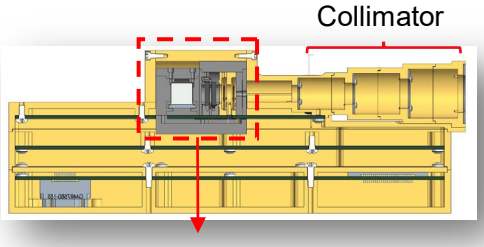


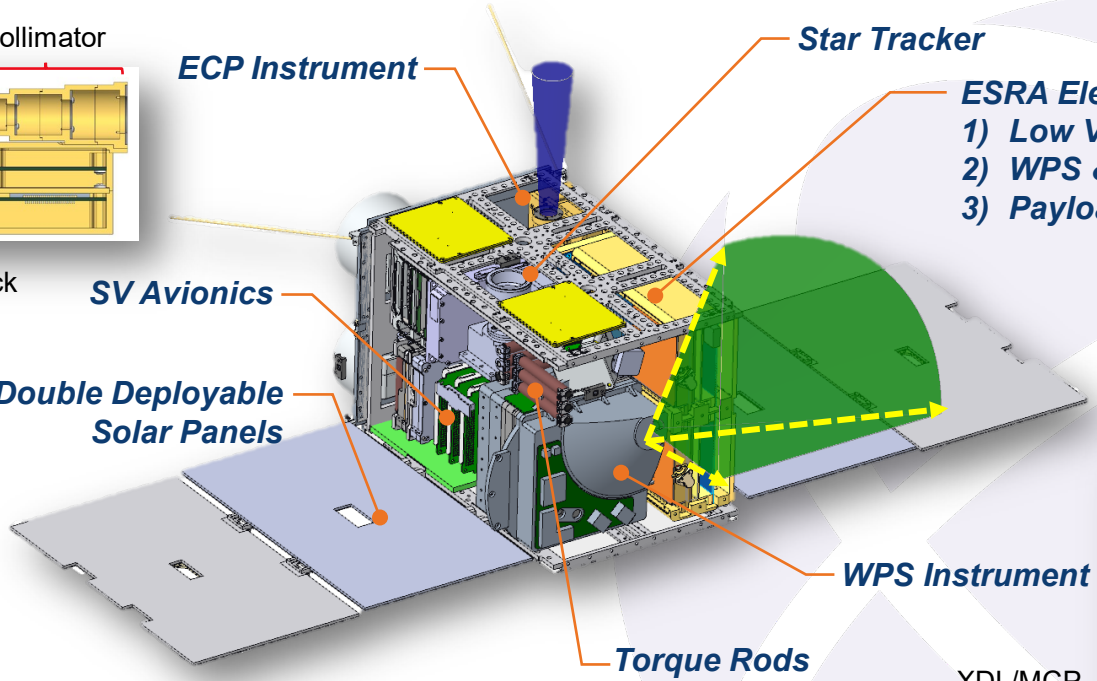
Payload Flight Processor evaluation board during bench top testing

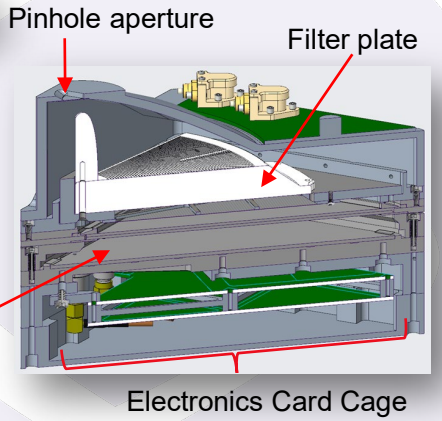
Description:

- Provide technology maturation that can be evaluated for future LANL, NASA, and DoD flight missions
- Payload Processor (PP)
  - Employs a compact 3U Eurocard and open SpaceVPX architecture to reduce form factor while increasing performance
  - Will utilize quad-core LEON4 processor to provide lower cost, lower power, and high-performance capability
- Distributed Processor Module (DPM) for “smart sensors”
  - Utilize low-power FPGAs, microcontrollers, and flash memory to provide C&DH at the sensor head location
  - Enables non-conventional layouts for sensor/instruments relative to central flight processors
- High Voltage Power System (HVPS)
  - Develop modular HVPS
  - VPX compliant form factor, standardize low voltage design, & plug in HV elements
- Flight Software (FSW)
  - Validate a generic and re-usable framework for LANL missions

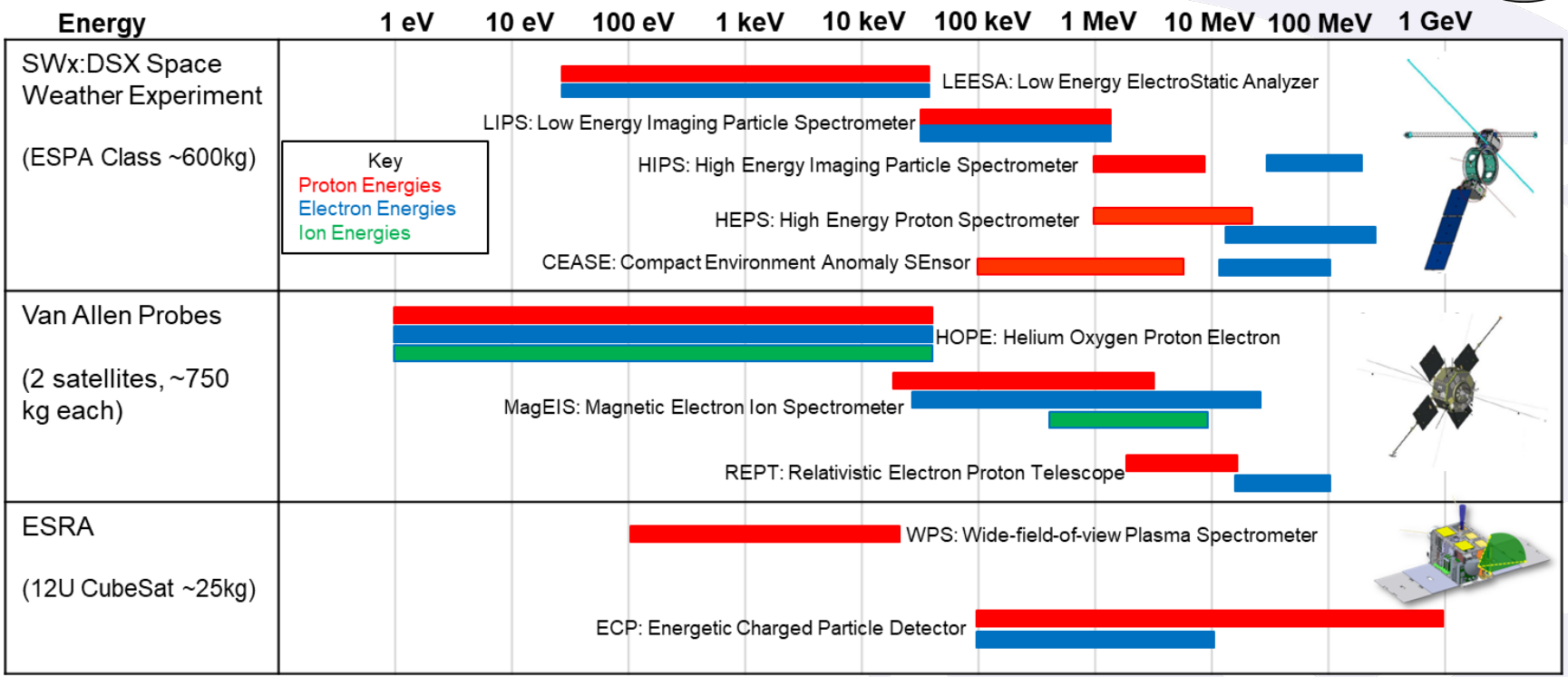
ESRA Space Vehicle Overview







Comparison to DSX and Van Allen Probes

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